P3 & Design-Build

101st Annual THE Conference
February 25th, 2015

Speaker:
Andrew Gensch, P.E.
Presentation Outline

• **Ohio River Bridges Project Overall Discussion**
  • Downtown Crossing and East End Locations
  • Program Goals
  • Cost
  • Schedule

• **Downtown Crossing**
  • Project Overview/Facts, Teams, Delivery Method
  • Sections 1, 2, and 3 – Overview, Technical Highlights, Challenges/Solutions

• **East End Crossing**
  • Project Overview/Facts, Teams, Delivery Method
  • Sections 4, 5, and 6 – Overview, Technical Highlights, Challenges/Solutions
Project Location – Louisville, Kentucky

- Downtown Crossing
- East End Crossing
Project Goals

• Provide regional redundancy for Ohio River Crossings (Both Projects)

• Add additional crossing over the river east of Louisville (East End)

• Provide by-pass around downtown Louisville for traffic to I-65 north and east (East End)

• Upgrade the outdated “spaghetti junction” intersection downtown Louisville (Downtown Crossing)

• Rehabilitate existing JFK bridge (Downtown Crossing)

• Construct C-D system north of river in Indiana (Downtown Crossing)
Project Delivery Methods

• **Downtown Crossing – Design Build**
  - Design and construction services are contracted by a single entity - DBT
  - Teaming Agreement
  - RFQ Submission
  - Shortlist
  - Prelim Design and Estimate
  - Contract Award Based on Price and Technical Score
  - Project Execution

• **East End – Public Private Partnership (P3, or PPP)**
  - Operation and Maintenance
  - Warranty Period
  - Flow Down provisions from agreements between Design Builder and Concessionaire
  - Interaction with the project owner – limitations
  - The review cycle – Concessionaire has a say!
## Project Cost

<table>
<thead>
<tr>
<th>Project Segment</th>
<th>2012 IFP</th>
<th>2013 Update</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downtown Crossing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section 1 - Kennedy Interchange</td>
<td>659.8</td>
<td>586.4</td>
<td>(73.4)</td>
</tr>
<tr>
<td>Section 2 - Downtown Bridge</td>
<td>357.8</td>
<td>323.2</td>
<td>(34.5)</td>
</tr>
<tr>
<td>Section 3 - Downtown IN Approach</td>
<td>197.7</td>
<td>182.9</td>
<td>(14.8)</td>
</tr>
<tr>
<td>Kentucky Other Costs</td>
<td>92.3</td>
<td>176.2</td>
<td>83.9</td>
</tr>
<tr>
<td><strong>Total Downtown Crossing</strong></td>
<td><strong>1,307.6</strong></td>
<td><strong>1,268.7</strong></td>
<td><strong>(38.9)</strong></td>
</tr>
<tr>
<td>East End Crossing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Section 4 - KY East End Approach</td>
<td>737.6</td>
<td>500.7</td>
<td>(236.8)</td>
</tr>
<tr>
<td>Section 5 - East End Bridge</td>
<td>284.4</td>
<td>247.5</td>
<td>(36.9)</td>
</tr>
<tr>
<td>Section 6 - IN East End Approach</td>
<td>196.1</td>
<td>218.7</td>
<td>22.6</td>
</tr>
<tr>
<td>Indiana Other Costs</td>
<td>58.2</td>
<td>108.7</td>
<td>50.5</td>
</tr>
<tr>
<td><strong>Total East End Crossing</strong></td>
<td><strong>1,276.3</strong></td>
<td><strong>1,075.7</strong></td>
<td><strong>(200.6)</strong></td>
</tr>
<tr>
<td><strong>PROJECT TOTAL</strong></td>
<td><strong>2,583.9</strong></td>
<td><strong>2,344.4</strong></td>
<td><strong>(239.5)</strong></td>
</tr>
</tbody>
</table>

(1) Totals may not sum due to rounding.

(2) Other Costs include project-wide costs that are not specific to individual project sections and include such costs as those incurred for historic mitigation and enhancements (not tied to any particular section), project development, general engineering and other professional fees and administrative expenses. Kentucky’s share of project-wide costs is shown as part of the Downtown Crossing expenditure and Indiana’s share of project-wide costs is shown as part of the East End Crossing expenditure.

(3) Project costs do not include financing and interest costs, addressed in Chapter 4.
## Project Schedule

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Downtown Crossing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right-of-Way</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other *</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>East End Crossing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Right-of-Way</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilities</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Includes state costs for toll system, project-wide mitigation, and oversight costs. **IFP did not include Other category.

Source: kyinbridges.com
Downtown Crossing – Design Build
Downtown Crossing Location – Louisville, Kentucky
Downtown Crossing Project Facts/Overview

- Section 1 - Reconfigure Spaghetti Junction (I-64, I-65 and I-71) (Blue)

- Section 2 - Build a new I-65 bridge with six northbound lanes (Yellow)

- Section 2 - Rehab Kennedy Bridge (I-65) with six southbound lanes (Yellow)

- Section 3 - Reconfigure Indiana roadway and bridge approaches (Red)

- Project Cost $1.27B
Downtown Crossing Project Team

Design Build Team:

- **JACOBS** - Management, Structures, Geotechnical, MOT, River Hydraulics
- Applied Research Associates – Bridge Security
- Buckland and Taylor – Cable Stay Designer
- Earth Exploration - Geotechnical
- GRW – Lighting, Electrical, Utilities
- International Bridge Technologies – Independent Bridge Check
- Linebach Funkhouser – Contaminated Materials
- MacDonald Architects – Bridge Lighting Aesthetics
- Clough, Harbour & Associates (formerly RW Armstrong) – Section 3 Road, Drainage, Structures
- Rowan, Williams, Davies, and Irwin (RWDI) – Wind Engineering
- Stantec – Section 1 Bridges, Drainage, Roadway – Project Wide Aesthetics

Owner:

KENTUCKY TRANSPORTATION CABINET
Downtown Crossing Design Offices

- Project Office
- Section 1
  - St. Louis
  - Lexington
  - Louisville
- Section 2
  - Seattle/Vancouver
- Section 3
  - Indianapolis
  - St. Louis
Downtown Crossing – Section 1 Overview

- Downtown Louisville at the intersection of I-64, I-65, and I-71
- 48 permanent bridges, 3 temporary, 30 walls, 25 ramps
Downtown Crossing – Section 1 Technical Highlights

- Multiple stages of MOT
- Complex geometry with 3 intersecting interstates, multiple fly over bridges
- Limited ROW to the south on I-65, staged bridge construction
Downtown Crossing – Section 1 Challenges/Solutions

• Challenge
  • Initial Design – Friction Piles
  • Unanticipated subsurface conditions discovered after most substructure design was complete
  • First Pile drives made several feet of progress first blows

• Solution
  • Substructure was redesigned
  • Fewer, Smaller Piles
  • Driven to Rock
  • Resulted in Material / Schedule Savings
Downtown Crossing – Section 1 Challenges/Solutions

• **Challenge**
  - Complex MOT and Utility Coordination
  - Multiple Stages

• **Solution**
  - MOT Task Force meetings with designer, contractor, owner, interested parties
  - Utilized multiple traffic calming methods
  - Involved local police for traffic enforcement
  - On going revision process to accommodate dynamic construction environment
Downtown Crossing – Section 2 Overview

- NB I-65
  - Cable Stay Bridge and Indiana Approach Bridge
- SB I-65
  - Existing Steel Truss JFK Bridge and Indiana Approach Bridge
Downtown Crossing – Section 2 Overview

Existing JFK Bridge 2,497’

Cable Stayed 2,106’

NB Approach 1,060’

SB Approach 659’

18
Downtown Crossing – Section 2 Technical Highlights

NB I-65 Cable Stay Bridge Design

3 Towers (Center Tower 254’ Tall, North and South Towers 198’ Tall)

4 Spans (Center Spans 750’ Long, Outer Spans 303’)

LOUISVILLE, KENTUCKY

JEFFERSONVILLE, INDIANA

V.P. 1. 236+50
EL. 511.88
L=500'

V.P. 1. 250+70
EL. 503.39
L=600'

303’-0”
SPAN 2

750’-0”
SPAN 3

303’-0”
SPAN 4

303’-0”
SPAN 5

2106'-0”

SCALE 1”=100’

EXP. JOINT

DRILLED SHAFTS TYP.

NORMAL PSCL EL. = 418.7

APPROXIMATE RIVER BOTTOM

APPROXIMATE ROCK LINE

APPROXIMATE NAVIGATIONAL CLEARANCE MIN.

+1.00%
Downtown Crossing – Section 2 Technical Highlights

Cable Stay Bridge Design
Downtown Crossing – Section 2 Challenges/Solutions

**Challenge**
- Design Structure for durability
- Different Exposure Zones

**Solution**
- Delineate Exposure Zones
- Develop Zone Specific Durability Criteria
- Design Modifications –
  - Concrete Mix – Flyash and Slag
  - Rebar Coating requested from KYTC
  - Corrosion Inhibitor at Road Level

Durability Design of Structure
Downtown Crossing – Section 2 Challenges/Solutions

• **Challenge**
  • Determine the effects of Wind on Structure during construction and when completed.

• **Solution**
  • Scale Model of Existing JFK and new Bridge Built in Wind Tunnel
    • Modeled Completed Cable Stay Bridge
    • Modeled Various Critical points During Construction for Stability
Downtown Crossing – Section 2 Photos
Downtown Crossing – Section 2 Photos
Downtown Crossing – Section 2 Photos
Downtown Crossing – Section 2 Photos
Downtown Crossing – Section 2 Photos
Downtown Crossing – Section 3 Overview

- Ties in to Existing JFK and new Cable Stay Bridge (Red)
- I-65 roadway reconstruction
- Clark Memorial Bridge direct access to NB I-65 (Yellow)
- 20 Bridges, all but 1 concrete.
- CD system overhaul
Downtown Crossing – Section 3 Technical Highlights

- Bridge B11 Fly over Bridge
Downtown Crossing – Section 3 Challenges/Solutions

• **Challenge**
  • Reconstruct the structural elements to the approach of the Clark Memorial bridge while maintaining historic block features.

• **Solution**
  • Bridge was surveyed with Lidar and each block was individually numbered for reassembly.
  • A specific plan package was put together for block removal and reassembly.
East End Crossing – P3
East End Crossing Project Location – Prospect, KY
East End Crossing Project Facts/Overview

- Completes I-265 loop
- New Cable Stay Bridge over the Ohio River
- New Tunnel under the historic Drumanard Estate
- Greenfield Roadway Section in Indiana
- Project Cost = $1.08B
East End Crossing Project Team

Owner / Developer / Builder

Design Team

- **American Structurepoint Inc.** – Section 6 Design
- **Stantec** – Geotechnical for Section 4 and 5
- **Earth Exploration Inc.** – Geotechnical for Section 6
- **Buckland and Taylor** – Section 5 Independent Design
- **International Bridge Technology** – Section 5 Superstructure Design
- **Wiss Janney Elstner** – East End Bridge Corrosion Protection Plan
- **Carman** – Landscaping
- **Macdonald Architects** – East End Bridge Aesthetics
- **Global Solutions** – Civil Engineering and General Support
- **Rowan Williams Davies and Irwin** – Wind Study
- **PCS Engineers** – Section 4 Noise and Safety Walls
- **Applied Research Associates** – East End Bridge and Tunnel ATVA
East End Crossing Design Offices

- **Project Office**
- **Section 4**
  - Dallas (Non-Tunnel)
  - New York (Tunnel)
- **Section 5**
  - Morristown
  - San Diego
- **Section 6**
  - Indianapolis
East End Crossing – Section 4 Overview

- Begins at KY 841 / I-71 Interchange
- Passes thru a depressed section
- A Tunnel extending 1700 feet under US 42 and the historic Drumanard Estate
- Crosses over a creek - 5-span twin Steel structures – Max span 350’
- High fill area – fill > 60’
- Connects to East End Bridge
East End Crossing – Section 4 Technical Highlights

- Tunnel Fire protection – Reduced Design Fire
- Harrods Creek Bridge – up to 350’ Span
- Approach Structure to Main Span Bridge
East End Crossing – Section 4 Challenges/Solutions

**Challenge**
- Impact of pile driving on LWC’s water filtration tunnel
- Impact of pile driving on LWC’s Sludge Pond
- Challenging rock conditions during construction of rock and soil anchored walls
- Harrods Creek Bridge Foundation – differing rock elevation

**Solutions**
- Engaged original tunnel designers to evaluate
- Sheet piling as cut off wall
- Existing soil characterization study
- Provide different option for different conditions
- Geo-tech Engineer on site
- Changed foundation type to Drilled shaft
East End Crossing – Section 4 Photos
East End Crossing – Section 4 Photos
East End Crossing – Section 5 Overview
3 span, Two tower, cable stay structure over the Ohio River; 2500 feet long; Towers are ~300 ft tall; 71 feet minimum vertical clearance from river normal pool; Four lane section, scalable to six lane; 13 foot pedestrian and emergency access path
East End Crossing – Section 5 Overview
East End Crossing – Section 5 Technical Highlights

- Stringent Corrosion Protection Requirements
- Avoidance of Fracture Critical Steel members
- Independently checked design
- Bridge construction method
East End Crossing – Section 5 Technical Highlights
East End Crossing – Section 5 Challenges/Solutions

**Challenges**
- Access to construct Indiana side pier and abutment
- Rebar and Miscellaneous items conflict
- Expansion Joint System – Longitudinal and Vertical Movements
- Additional Vibration from Wind Analysis

**Solutions**
- Grading plan
- Integrated Drawings
- Used Modular Joints by Mageba
- Added cable stay braces, open barrier
East End Crossing – Section 5 Photos
East End Crossing – Section 6 Overview

- Mostly Green Field Construction
- Reconstruction of I-265 and SR 62 Interchange
- Addition of new full interchange at Old Salem Road
East End Crossing – Section 6 Technical Highlights

RID Design
East End Crossing – Section 6 Technical Highlights

Roundabout Interchange
East End Crossing – Section 6 Technical Highlights
Questions?
Downtown Crossing – Section 3 Challenges/Solutions

Tolling

**Challenges**
- 1- Tolling Requirements for Design / Toll Integrator Selection
- 2- Due to RFP requirements, both the East End and Downtown must be turned on as soon as either bridge is open to traffic.

**Solutions**
- 1- Design barriers, medians, and foundation locations to meet the most likely number of scenarios for tolling infrastructure.
- 2- A temporary tolling system was designed and installed to capture tolls in the interim condition, and was designed not to conflict with the permanent condition.
Downtown Crossing – Section 2 Photos
Downtown Crossing – Section 2 Photos
East End Crossing – Section 6 Challenges/Solutions

• **Challenges**
  - Deck Replacement of Existing Bridges
  - MOT of a busy interchange (with heavy railroad passing thru it)

• **Solutions**
  - Challenge in protecting beams – Fixes to damages
  - Collaboration with Builder during construction and traffic phasing